A Computer Atlas of Hydrologic and Geomorphologic Data for Small Watersheds in Indiana

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Abstract

Banks of hydrologic and geomorphologic data for Indiana small watersheds were prepared for computer use. Four major types of data were collected: rainfall, and runoff data for 55 watersheds; and drainage networks and topographic data for 34 of these watersheds. The data were loaded on four magnetic tapes. The first tape contains the single storm rainfalls and runoffs; the second, the single storm rainfall excesses and direct runoff hydrographs; the third, the planforms of stream networks; and the fourth, the elevation contours of the watersheds. Such data are useful in hydrograph analysis, estimation of instantaneous hydrographs, identification and calibration of hydrologic models for runoff estimation. They have applications in drainage design, development and management of water resources.

Introduction

The following hydrologic and geomorphologic information for several Indiana watersheds is stored on magnetic tape:

1) Single storm rainfalls
2) Single storm rainfall excesses
3) Single storm runoff hydrographs
4) Single storm direct runoff hydrographs
5) Planform of stream networks
6) Contour maps of watersheds

For complete details the reader is directed to Ref. 6.

Data Acquisition

The selection of the watersheds was determined by: 1) the desire to cover most of the regions of the state of Indiana, and 2) the condition that man-made disturbances were not predominant factors controlling the behavior of the watershed. The rainfall data were obtained from the U.S. Dep. of Comm., Environ. Sci. Serv. Admin. (11). Stage hydrographs and stage-discharge tables were obtained from the U.S. Geol. Surv. (10). The drainage network was compiled from the Indiana County Drainage Atlas prepared by Purdue University (8).

All the Indiana watersheds under 300 miles^2 for which the U.S.G.S. has records were considered and those having at least 7 to 10 well-defined, single peak stage hydrographs were selected. The stage hydrographs were digitized at 30 min intervals and were read to the nearest 0.05 foot. The rating curves used to convert stages into flows

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were digitized at 0.1 foot stage increment. An average of 200 data points (time-stage) were recorded for each hydrograph.

Precipitation records from over 150 recording stations in Indiana were assembled (11). For the majority of the watersheds, it was not possible to find several stations inside the watershed boundaries. In such cases, stations were selected in the close vicinity of the watershed boundaries. The arithmetic average of the records from those stations was taken to obtain the mass precipitation curve for the storm which was recorded at one hour intervals to the nearest 0.01 inch. Topographic data were digitized from U.S. Geological Survey 1/24,000 quadrangle and 1/125,000 topographic maps. All these sets of data were digitized and recorded on computer cards. The CALCOMP plotter was used to display the data for checking purposes. Then the data were loaded on magnetic tapes.

Total Rainfall and Total Runoff

This section of the hydrologic library contains 1,059 single peak hydrographs over 55 watersheds. The hydrograph ordinates are digitized at 30 min intervals. The corresponding average hourly precipitations over the watersheds were loaded on the same tape.

Effective Rainfall and Direct Runoff

This section of the library is on a separate magnetic tape and contains the direct runoff hydrograph ordinates and the corresponding excess precipitations for the same 1,059 hydrologic events. The direct runoff was obtained by subtracting the base flow from the observed runoff. The base flow separation assumed that the majority of Indiana streams are sustained by unconfined aquifers. The excess precipitation was obtained by multiplying the ordinates of the total rainfall hyetograph by the ratio of the total amount of rainfall during the storm to the total precipitation excess.

Drainage Network

The third part of the data bank consists of 34 drainage networks. The computer programming procedures for the definition of stream networks were reported by Coffman *et al.* (3). A drainage network was defined by a sequence of three quantities: an X-Y coordinate pair which represents the longitude and latitude of the stream sources, junctions and basin outlet and a code identifying the type of point. Small basins requiring less than 3,000 sampling points, (usually smaller than 20 to 30 miles^2) are treated as a single unit; those requiring more sampling points are divided into sub-basins.

Topography

The fourth part of the data bank contains the contours and boundaries of 38 watersheds. The X and Y coordinates of points located along the contours were digitized from USGS topographic maps, 31 at the 1/24,000 scale and 7 at the 1/125,000 scale.

Tapes, Formats, Coding Details and Availability

The details of the tapes, formats and the programs necessary to read the tapes or to write similar data on a tape have been given by Lee, Blank and Delleur (6). Copies of the tapes are available at cost and inquiries should be addressed to J. W. Delleur.

Hydrologic Applications

The principal hydrologic applications of the data bank are the estimation of instantaneous unit hydrographs, unit hydrographs and runoff hydrographs. Blank and Delleur (1) have discussed in detail the calculations associated with the hydrograph estimation using the data bank and have given several examples and the associated computer programs. The mathematical and computational techniques used in the estimation of the instantaneous unit hydrograph by the transform method have been reported in detail by Rao and Delleur (9). These reports have been summarized in three papers published in the open literature and are listed under references (2, 4, 5).

Geomorphologic Application

Recent developments in quantitative fluvial geomorphology are closely related with the classification of stream networks which requires a considerable amount of data to support its fundamental principles. The availability of this data bank leads to a possible way of handling complex stream networks by computer. Quantitative geomorphologic relationships governing the hydrologic behavior of watersheds can also be studied. An example of Calcomp plotter restitution of stream network data is shown in Figure 1.

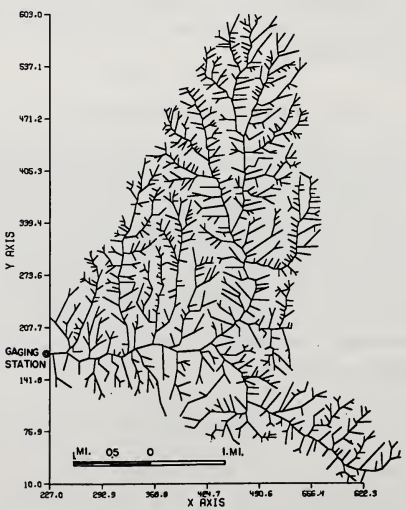

FIGURE 1. *Calcomp restitution of stream network data on magnetic tape for Bean Blossom Creek at Bean Blossom, Indiana.*

There are two phases of runoff estimation in Indiana small watersheds which have been completed at the Water Resources Research Center at Purdue University. They are: 1) the utilization of WATER system (3) for stream network analysis of a number of Indiana watersheds; 2) the application of geomorphologic data for hydrologic modeling in some Indiana watersheds. The results of these applications were reported by Lee and Delleur (7).

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